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THE LUMINESCENCE OF DIAMOND—II

SIR C. V. RAMAN

1. LUMINESCENCE AND CRYSTAL STRUCTURE

THE spectral character of the visible luminescence excited in diamond by irradiation with long-wave ultra-violet light was described and illustrated in an earlier article of this series, and the remarkable diversity of behaviour displayed by different specimens of diamond in these circumstances was duly stressed. Why this should be so is a problem which might well have remained unsolved, had it been an isolated issue. At our early stage of the Bangalore investigations, however, it became apparent that luminescence was only one of a whole group of physical properties of diamond which exhibit large variations, and that these are interrelated with each other. A detailed study of the situation was made possible by the circumstance that the collection of material included a large number of polished cleavage plates of diamond—a form which is exceptionally well-suited for such investiga-

tions. It will suffice here to mention four series of studies made with these plates which covered the following topics: (a) the absorption in diamond of ultra-violet radiation of wave-lengths between $\lambda 2000$ and $\lambda 3000$; (b) the absorption of infra-red radiation of wave-lengths between 6μ and 12μ ; (c) its structural birefringence; and (d) the intensity of X-ray reflections by the lattice planes of the crystal.

That physical properties so different in their nature as those stated above exhibit variations correlated with each other and with luminescence is by itself an indication that a common cause underlies all the variations. Of particular importance in this connection was the discovery that a good many of the plates exhibited luminescence of varying colour and intensity over their area, showing geometric patterns with a configuration related to the structure of

the crystal. This suggested investigations by appropriate methods of the other properties listed above, and the result emerged that the cleavage plates which showed geometric patterns of luminescence also exhibited patterns of ultra-violet transparency, patterns of infra-red transmission, patterns of structural birefringence and patterns of X-ray reflection intensity; the geometric features of all these patterns bore a recognizable relationship with each other. The evidence for the structural origin of the whole group of effects was thereby greatly strengthened.

It is proposed in this article to present the experimental facts briefly summarised above.

diamond. The technique of photographing their patterns so as to exhibit the relationship between them has recently been greatly improved, and a whole series of new photographs by Mr. A. Jayaraman were reproduced with a paper which appeared in the *Proceedings* of the Indian Academy of Sciences for August 1950. Other photographs taken with the same apparatus illustrate the present article (Figs. 1 and 6 below).

2. THE LUMINESCENCE PATTERNS

In order to observe or photograph its luminescence, the diamond is placed on a piece of black glass and irradiated by a beam of sunlight filtered through a plate of Wood's glass and

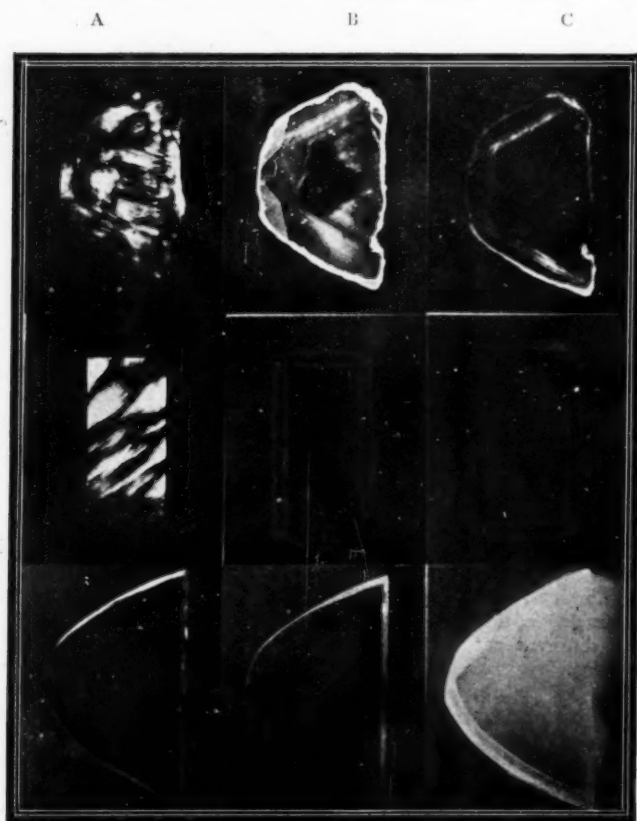


FIG. 1

Luminescence and Birefringence Patterns of Three Representative Diamonds.
(A) Birefringence, (B) Green Luminescence and (C) Blue Luminescence.

in somewhat greater detail. Of particular significance and importance is the relationship between luminescence and birefringence in the luminescence which arises from the

electronic transition at $\lambda 4152$ and its associated vibrational transitions. Similarly, viewing the diamond through a filter which has a cut-off for wave-lengths shorter than $\lambda 5400$, the blue part of the luminescence is extinguished, while the luminescence arising from the electronic line at $\lambda 5036$ and its associated vibrational transitions can be seen, though with considerably reduced intensity.

have a group which exhibits "blue" luminescence. This is more or less perfectly uniform in intensity over the area of the plate, while observations through the appropriate filter show the "green" luminescence to be either weak or wholly absent. Secondly, we have a group which exhibits neither the blue nor the green luminescence with observable intensity. Such diamonds may, therefore, be classed as non-

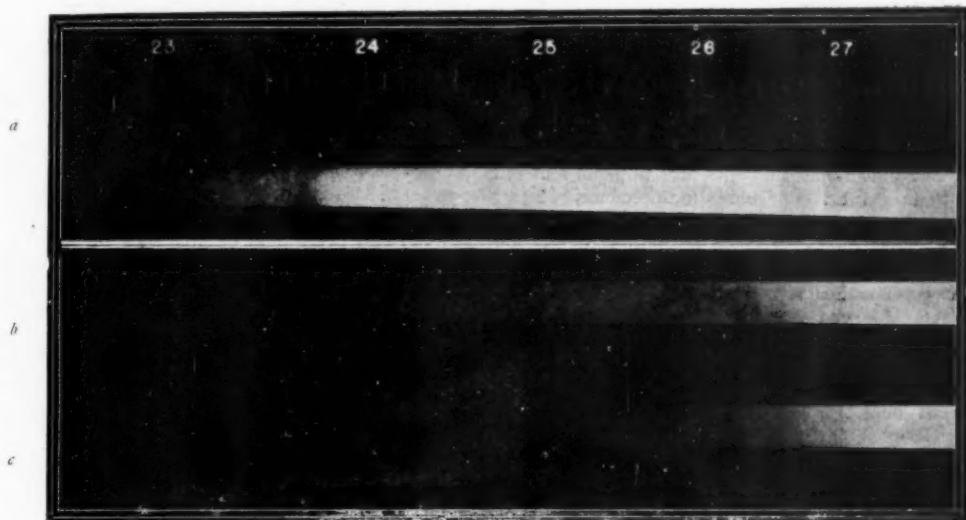


FIG. 2

Ultra-Violet Absorption in Blue-Fluorescent Diamond of different thicknesses.

(a) 0.15 mm., (b) 0.30 mm. and (c) 0.37 mm.

(After K. G. Ramanathan)

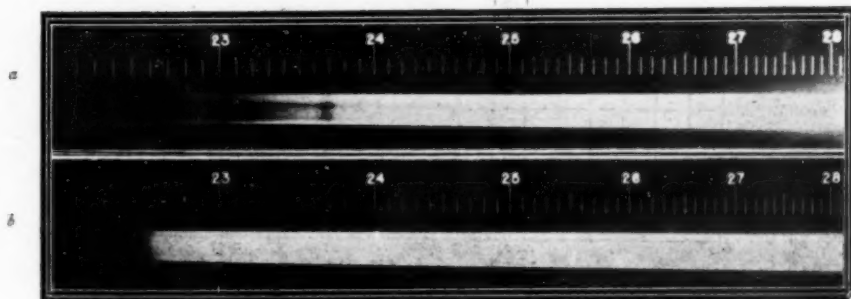


FIG. 3

Ultra-Violet Absorption in (a) Green-Fluorescent Diamond and (b) Non-Fluorescent Diamond.

(After K. G. Ramanathan)

Over a hundred cleavage plates of diamond included in the Bangalore collection have been studied in the manner described. They are found to fall into three groups. Firstly, we

fluorescent. Thirdly, we have a group comprising the majority of our specimens. These exhibit geometric luminescence patterns, the nature of which varies greatly from specimen

to specimen. In some diamonds, part of the area is non-fluorescent while the rest exhibits the "blue" luminescence usually accompanied by a weak green luminescence, as shown by observation through the filter. There are, however, many specimens in which the presence of both types of luminescence is evident even without the aid of the filter. Viewed through the filter which cuts out the blue luminescence, the "green" luminescence becomes apparent as parallel bands of a greenish-yellow colour traversing the plate in different directions. The assistance of the filter enables such bands to be detected in areas which show only blue luminescence without such aid.

We may summarise the position by the statement that some diamonds are non-luminescent, others exhibit only blue luminescence, while a third class exhibits a more complex behaviour in which the appearance of both the blue and green types of luminescence with varying relative intensities is a characteristic feature. The facts observed suggest that this third category of specimens may be described as being a "mixture" of the first two kinds of diamond, namely, the non-fluorescent and blue-fluorescent ones. Their juxtaposition is evident in

3. PATTERNS OF ULTRA-VIOLET TRANSPARENCY

A simple technique was developed for the study of the transparency of cleavage plates of diamond to the ultra-violet radiations of the mercury arc in quartz. The most intense part, viz., the resonance radiation of wave-length $\lambda 2537$ is separated from the rest by the use of a dispersing assembly composed of a quartz prism and a pair of quartz lenses. The radiation thus isolated falls on the cleavage plate of diamond which is held attached to a thin sheet of canary-yellow or uranium glass. The fluorescence excited in the latter in the parts screened by the diamond reveals whether any of the incident radiation is transmitted by the latter. The parts that are opaque to the radiation appear dark in the fluorescent glass. Those that are transparent show the full intensity, while partial transparency is indicated by a diminished brightness of fluorescence.

Observations made by this technique reveal the correlation which exists between the ultra-violet transparency of a diamond to the $\lambda 2537$ radiation and the luminescence excited in it by ultra-violet radiation of much greater wavelengths. Non-fluorescent diamonds are completely transparent to the $\lambda 2537$ radiation.

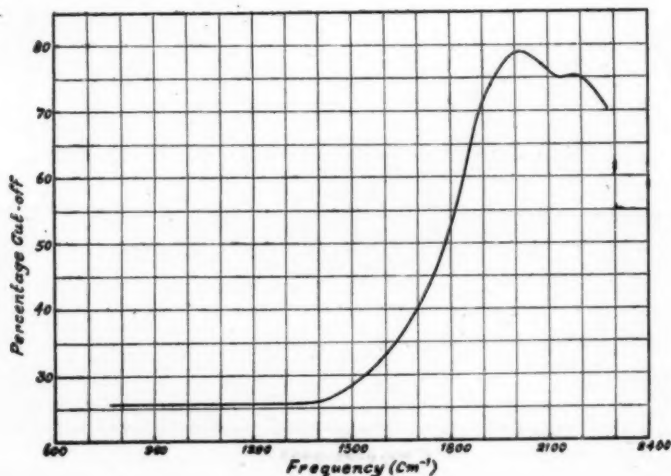


FIG. 4

Infra-Red Transmission by Non-Fluorescent Diamond.

some specimens on a simple inspection of their luminescence patterns. In other specimens, especially those showing the green luminescence prominently, the mixture appears to be on a finer scale.

Diamonds which fluoresce blue with weak or moderate intensity are opaque to the same radiation. "Mixed" diamonds which are in part non-luminescent and in part blue-luminescent show these parts as respectively transparent and

opaque to the λ 2537 radiation. The diamonds which are green-fluorescent exhibit a marked transmission, which is however distinctly inferior to that of non-fluorescent diamond. Strongly blue-luminescent diamonds show a weak but nevertheless observable transmission of the λ 2537 radiation.

It is obvious that the terms transparency and opacity used above can have a precise meaning only if the thickness of the plate and its percentage of transmission are specified. The investigations made reveal that while all diamonds show a complete cut-off for wavelengths less than λ 2250, it is possible by reducing the thickness sufficiently to observe a transmission down to that limit even in the case of diamonds which in thick layers are opaque beyond λ 3000. This effect is illustrated in Fig. 2 for a diamond of the blue luminescent type.

diamonds irrespective of their behaviour in luminescence show an absorption in the infra-red region between 7μ and 4μ . This is a second-order absorption due to the octaves and combinations of the characteristic frequencies of the crystal lattice.

5. PATTERNS OF STRUCTURAL BIREFRINGENCE

We are not here concerned with the accidental birefringence due to visible flaws or inclusions in diamond, but will consider only the birefringence having a structural origin observed in plates which appear otherwise faultless. The effect, if present, is readily observed when the plate is held between crossed polaroids and viewed against a bright source of light. Since the optical effects arising from a local stress extend far beyond the point of its application, while, on the other hand, luminescence is an essentially localised phenomenon, we cannot expect a perfect correspondence between the

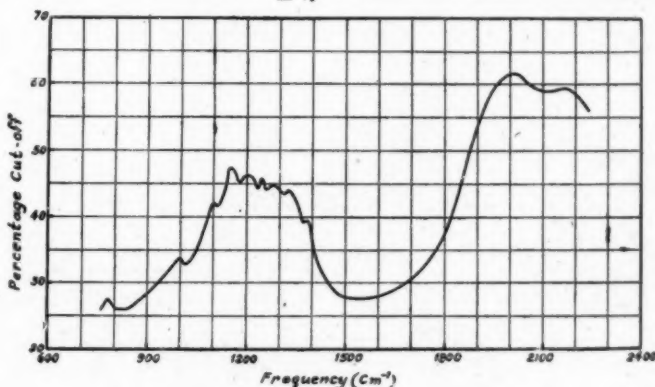


FIG. 5

Infra-Red Transmission by Green Fluorescent Diamond

4. PATTERNS OF INFRA-RED TRANSMISSION

Investigations reveal a precise correlation between the transparency of diamond to infra-red radiation in the 8μ region of wave-length and its behaviour in respect of luminescence. When appropriate corrections are made for reflection at their surfaces, non-luminescent diamonds are found to be completely transparent to infra-red radiation of wave-length 8μ , while diamonds which are blue-fluorescent with weak or moderate intensity show a strong absorption in that region. The absorption is, however, distinctly less for diamonds which exhibit an intense blue luminescence. Diamonds which exhibit a green luminescence have only a weak absorption in the 8μ region and indeed approach the non-fluorescent diamonds in their behaviour. It should be remarked that all

luminescence and birefringence patterns. Nevertheless, the effects observed, especially in plates of small thickness, are sufficiently striking to carry conviction. The numerous specimens available for the study enable a complete correlation to be established.

The diamond plates in the collection may be divided into three categories. *Firstly*, we have a group which exhibits little or no birefringence and makes a near approach to the perfect optical isotropy to be expected in a cubic crystal. Such diamonds invariably exhibit "blue" luminescence, its intensity being more or less perfectly uniform over the area of the specimen. *Secondly*, we have a group of diamonds which exhibit a characteristic type of lamellar birefringence: fine streaks are seen running parallel to the octahedral of the

dodecahedral planes of the crystal, the alternate layers exhibiting positive and negative birefringence as determined with the aid of a Babinet compensator. Diamonds which exhibit

the area of the plate. The presence of such bands in birefringence goes hand in hand with the appearance of green or greenish-yellow bands of luminescence as already described.

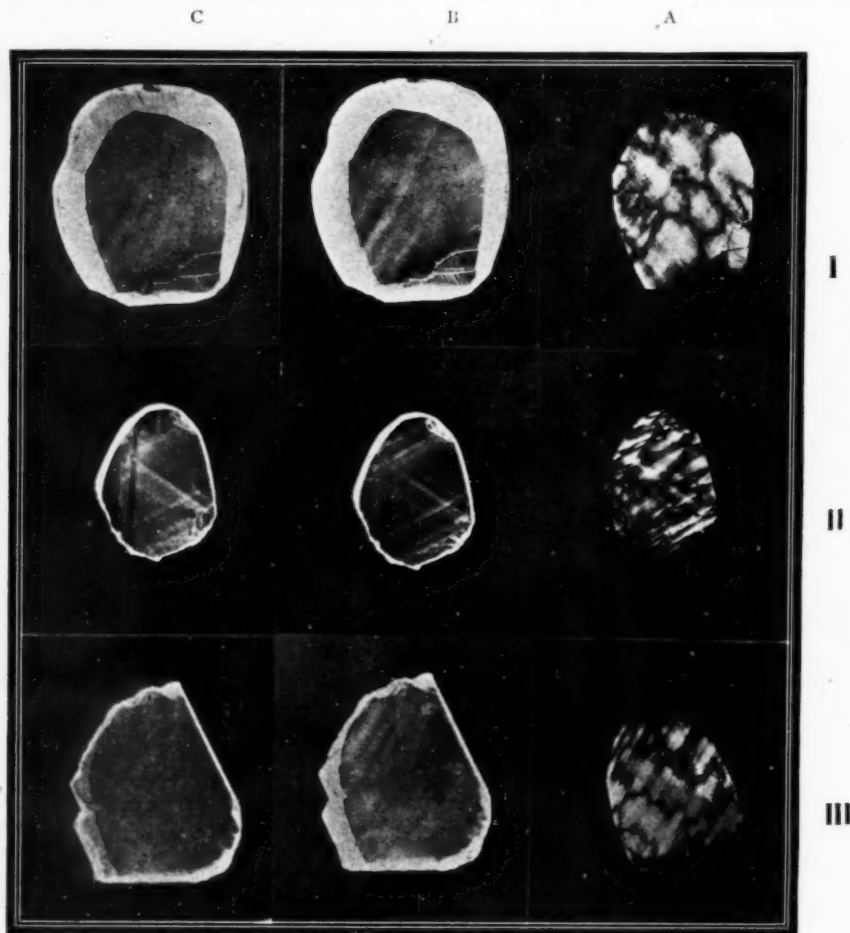


FIG. 6

Luminescence and Birefringence Patterns.

(A) Birefringence, (B) Green Luminescence and (C) Blue Luminescence.

this type of birefringence over their entire area are invariably non-luminescent. Thirdly, we have a group of diamonds in which the birefringence is a more complex character, varying from specimen to specimen. In some specimens, extensive areas are observed where the birefringence is of the type characteristic of non-fluorescent diamonds, while in other areas the birefringence is weak or absent as in the case of "blue" luminescent diamonds. More common are the specimens in which broad bands of birefringence run parallel to each other over

Figs. 1 and 6 above have been reproduced from photographs taken recently by Mr. A. Jayaraman and illustrate the foregoing remarks. The three photographs marked III in Fig. 1 illustrate a typical case of a blue-fluorescent diamond exhibiting no birefringence and no green luminescence. The three pictures marked II in the same figure represents a typical non-fluorescent diamond giving neither blue nor green luminescence but exhibiting a streaky birefringence. The three pictures marked I in the figure are photographs of a diamond which

exhibits both green and blue bands of luminescence over a greater part of the area, but has a central area which is non-fluorescent. The birefringence of the plate exhibits a banded structure having a recognisable relationship to the features observed in luminescence. This is better seen in Fig. 6 which reproduces the patterns of blue and green luminescence and birefringence of three typical diamonds of the third or mixed category. In Fig. 6 (I), the striking feature is the appearance of broad bands of yellow luminescence traversing the crystal. These run parallel to the broad bands of birefringence seen cutting across numerous fine streaks of the kind seen in non-luminescent diamond which appear in a different direction. A careful study of Figs. 6 (II) and 6 (III) will repay the reader for his trouble. They form excellent illustrations of the relations between luminescence and birefringence described in the foregoing pages.

6. PATTERNS OF X-RAY REFLECTION INTENSITY

The method of recording these patterns—also called X-ray topographs—is in principle simple and has been described in detail in the papers by Dr. G. N. Ramachandran on the subject. It makes use of white X-rays diverging from a pin hole to obtain the Laue reflections

from the full area of the cleavage plate. The reflections recorded may be either from the internal or the surface crystallographic planes, the technique necessary to obtain a undistorted picture of the crystal being different in two cases. Clear photographs can only be obtained with relatively thin plates.

The features observed in the X-ray topographs are very revealing. It is found that the weakly-blue luminescent areas make a near approach to the ideally perfect crystal structure and give the weakest Laue reflections. A greater intensity of blue luminescence results in a corresponding increase in the intensity of X-ray reflection. On the other hand, areas which are non-luminescent give extremely intense X-ray reflections. The reason for this is presumably the lamellar structure of the diamond which is evident also in the birefringence. It is found that the bands of greenish-yellow luminescence crossing the areas of blue luminescence are represented in the X-ray topographs by very bright streaks. This observation supports the inference that the "green" luminescence is a consequence of the admixture on a fine scale of the blue-luminescent and the non-luminescent types of diamond.

(To be continued)

INTERNATIONAL CONFERENCE ON ELEMENTARY PARTICLES

AN International Conference on Elementary Particles was organized by the Tata Institute of Fundamental Research, Bombay, from the 15th to 22nd December 1950. This is the first time that a conference of this type on such a high scientific level has been held in India. This was made possible by grants from various official and non-official organisations in India and abroad and specially, by a substantial subvention from the UNESCO, which enabled a number of distinguished scientists from abroad to attend the conference.

Studies on both experimental and theoretical aspects of the subject were discussed at the conference. The theoreticians were mainly interested in the fundamentals of quantum mechanics. For instance, Rosenfeld spoke on ideas of measurability developed by Bohr and himself, Peierls spoke on commutation laws in relativistic quantum theory, Perrin on spinors and Moller on non-localised quantum field theories. Discussions on the theory of elementary particles themselves were led by Bhabha who presented the relativistic theory in the latest form developed by him. Other papers were by Heitler on the production of mesons, Fermi on nuclear stars, Wentzel on nuclear reactions involving mesons, Eliezer on the equa-

tion for the electron and Majumdar on the radiative scattering of the electron.

Cosmic rays are still the main source of high energy particles for most of the experimenters although some studies have also been made with particles from powerful cyclotrons. The papers presented could broadly be classified into four types: (a) those dealing with the influence of factors like latitude and meteorological conditions on the intensity of cosmic rays; (b) those concerning the interaction of cosmic rays with atomic nuclei; (c) those aiming at discovering the primary constituents of cosmic rays; and (d) those describing the experimental techniques. In addition, Blackett presented some recent work on V-mesons discovered by his group, and showed photographs of their tracks in a cloud chamber.

Reviewing the present knowledge on cosmic rays, Saha concluded that they were probably galactic in origin, while Blackett was of the view that they need not necessarily be produced by nuclear reactions and that a mechanism analogous to the one which causes thunderstorms could well be responsible for the production of these high energies, as has been suggested by Fermi.

THE PRESENT CONCEPT OF THE PHYSICAL WORLD*

WITH a few notable exceptions, scientific activity in the modern sense did not begin till the Italian renaissance. It was Leonardo da Vinci who wrote in one of his manuscripts, "There is no certainty where one can neither apply any of the mathematical sciences nor any of those which are based on the mathematical sciences", and it expresses the new spirit of the times, a spirit which was to lead eventually to that vast development, which is modern science and technology. What Leonardo wished to emphasize, was that as long as an observation of a natural phenomenon remained couched in qualitative terms it would not be definite enough to build on, and only by introducing accurate measurement and quantitative relations into it could one be certain that it was right or wrong within the limits of accuracy of the measurements. Once this general approach received fairly wide acceptance, the development of science in the modern sense was inevitable.

It was found quite soon that certain properties, which could be stated in terms of exact measurement, were common to many objects. In certain cases, therefore, it became possible to state general laws without specifying the particular object to which it applied. In order to connect up such laws of nature with each other it may be necessary to formulate certain more abstract principles or postulates from which the various observed regularities can be deduced. Newton's fundamental laws of motion exemplify this approach. For instance, one might imagine his first law to be a statement arrived at from direct observation through some process of induction, viz., that if we could take a body into space to a very great distance from all other material bodies, then it would either remain at rest or move in uniform motion in a straight line. We know today that such an induction cannot be made, and may indeed not even be true for the actual world. This analysis shows us that strictly speaking Newton's laws of motion and gravitation are abstract mathematical statements which he quite rightly calls axioms. And if they came to be regarded as objectively true it is because the behaviour of objects which could be deduced from them by mathematical reasoning agreed with our direct observations.

We turn now to review the development of our picture of the physical world resulting

from recent discoveries. Round about 1930, the picture appeared to be remarkably simple. The whole material world was thought of as made up of just two types of elementary particles, protons and electrons. Light, or in more general terms, electro-magnetic radiation, or photons, and gravitation, were the only two other physical entities found in nature. A scientist at that time could have thought, as many did think, that when one knew the mathematical laws governing the behaviour of these four elementary types of physical entities, one would know everything of a fundamental nature that there was to know of the physical world. The subsequent development of the last twenty years shows us how far this belief was from the truth. It shows in a striking manner that however great the successes of a theory, unless this success is complete and total, it is always possible that something very important may have slipped through the net. The apparently small but persistent difficulties or inconsistencies in a theory, or small discrepancies between theory and observation, may be essentially unbridgeable within the framework of the basic concepts of that theory and yield the clue to new ideas.

Discrepancies of this sort were, in fact, present in the picture mentioned above. Experimental studies showed that all nuclei seemed to behave as if the electrons, which were supposed to be in them, only manifested their electric charge, but neither their spin nor their statistics, both of which depended only on the number of heavy particles present. A bold attempt to face this difficulty would soon have led one to the view that nuclei were not composed of protons and electrons but rather of protons and some hitherto unknown particle having the same mass as the proton, the same spin and satisfying the same statistics. A particle of this description was discovered by Chadwick in 1931 and was called a neutron. This discovery led to the acceptance of the picture that all nuclei are made up of only protons and neutrons. Since electrons are known to emerge out of radio-active nuclei, the concept of an elementary particle had to undergo a radical change, viz., that while the elementary particles are not composite and that as long as they exist they are immutable, nevertheless there are occasions when one or more such particles can disappear altogether with the simultaneous creation of another set.

In 1931, Anderson discovered the positron. The existence of this new particle could be understood immediately in terms of an equa-

* Summary of the Address given by the General President, Dr. H. J. Bhabha, to the Thirty-Eighth Session of the Indian Science Congress, held at Bangalore.

tion for the electron put forward by Dirac in 1928. Nevertheless, a consequence of this theory was that no electron or photon of even the highest energy could penetrate large amounts of matter, while a growing body of evidence from cosmic ray experiments indicated that particles which looked like electrons did in fact penetrate great thicknesses of matter. Thus, there seemed to be evidence that quantum theory failed for very high energy electrons, while at the same time there was no theory to explain the phenomenon of the cosmic ray showers. It was only when the Cascade Theory put forward by Heitler and the present author showed that the existence of cosmic ray showers and the behaviour of the soft component of cosmic rays in the atmosphere and in dense substances could be explained on the basis of quantum theory was it possible to conclude that the electron-like tracks of particles, which did not behave completely like electrons nor like protons, must be due to a new type of particle having an intermediate mass. Thus, the existence of a new particle called the meson, with a mass some 204 times that of the electron came to be established in 1938.

Since then, many types of mesons have been discovered, and we know now that at least nine different types of elementary physical entities exist in nature, while the existence of two more is almost certain. While experiments

may give us information about the masses of these particles, their mutual interactions and the processes in which they take part, it seems inconceivable that an experiment would enable us to deduce directly the mathematical equation describing the behaviour of any such particle. We can only hope to set up such equations by taking as our guides certain well-known principles, as for example the principle of relativity and the ideas underlying quantum mechanics.

It is clear that we are now penetrating into a new level of nature which was practically unknown some twenty years ago. The circumstance that there are a dozen different types of elementary particles in nature would lead us to expect that there may be many more, and indeed with our present knowledge we cannot exclude the possibility that there may be an infinite number of them. This does not mean, however, that we shall never be able to obtain a complete description of them all. It is quite possible that with increasing knowledge we may be able to find the formula which gives us the masses of all the elementary particles and the general principles which will allow us to deduce the equation satisfied by a particle of any particular mass. If this were not so, we would be faced with a situation in which we could never hope to give an exhaustive description of everything there is in nature, but only to extend with the flow of time the region which we had explored and understood.

WORLD-WIDE QUEST FOR URANIUM

THE quest for uranium during the last decade has been ever on the increase and has transformed the metal from a scientific curiosity to one of strategic importance. The realisation that the availability of uranium in the earth's crust is limited and capriciously distributed has restricted its use to mainly military purposes. To aid a world-wide search for uranium, the Governments of various countries are giving active help and encouragement. The results of governmental action have been remarkable. New types of radiation detection instruments to speed up the work of exploration have been evolved; several new discoveries of uranium minerals and ores of potential significance have been reported from Belgium Congo, U.S.A., Canada and Australia; new processes are being developed for more effective recovery of uranium from low-grade materials.

The British Government, like the others, have published two booklets, with a view to stimulate uranium production, which are reviewed by the timely Information Bulletin.*

The booklets deal with the nature of occurrence of uranium minerals, the techniques used to detect them and the methods of analysis including details of procedures evolved at the Chemical Research Laboratory at Teddington. These involve a minimum of laboratory equipment and chemicals and are ideally suited for prospecting expeditions. These booklets will be of invaluable help to prospectors.

The Government of India, through the Atomic Energy Commission, have announced recently their intention to give a fillip to prospecting and to buy all uranium ores. It would be of considerable assistance to Indian prospectors, of whom there are many these days, if the Indian Atomic Energy Commission would publish a handbook detailing the nature of occurrence of uranium in India and the techniques of prospecting. It would go a long way to fill a real need, help the prospectors and thereby the Government of India.

N. R. SRINIVASAN.

* Information Bulletin issued by B.I.S., New Delhi.

THE INFLUENCE OF NON-GLYCERIDIC CONSTITUENTS ON AUTOXIDATIVE RANCIDITY OF SESAME OIL

S. A. SALETORÉ AND N. H. HARKARÉ

(Laxminarayan Institute of Technology, Nagpur University, Nagpur)

SESAME oil used in these experiments unless otherwise stated, was specially pressed from good quality seed in a local wooden ghany. Storage stability tests were done by exposing 0.5 gm. of the oil sample in each of a series of clean pyrex test tubes $5\frac{3}{4}'' \times \frac{3}{4}''$, selected for uniformity of diameter to diffuse daylight and examining two tubes every few days. The test tubes were plugged loosely by cotton wool. Peroxide values were determined by a modification of Wheeler's method described in detail by the authors in a recent paper.⁴ The smell was observed by two different workers and classified according to the classification used by John, McConnell and Esselen.⁵

EXPT. (1) EFFECT OF SUSPENDED MUCILAGINOUS MATTER

Stability test runs carried out on the settled unfiltered oil as well as on oil filtered through a hot water jacketed glass funnel showed that both samples were free from any rancid smell after a period of 57 days, but smelled blank. The peroxide value increased from 2.2 to 14 in the case of unfiltered oil and from 7.7 to 34.7 in the case of filtered oil. The former retained its original bright yellow colour, but the latter, which was lemon yellow at start, became lighter after 4 days and then progressively increased in colour to an orange red.

EXPT. (2) EFFECT OF THE CONSTITUENTS PRESENT IN THE HUSK

Sesame seed was freed from the husk by soaking in water for two days in the dark and rubbing same between two layers of rough cloth. Oil from the de-husked seed as well as from the un-dehusked seed was solvent extracted with petroleum ether (60-80° C.) and dried under vacuum. The former was much lighter in colour and had a less distinctive smell. Storage stability tests carried out on both samples showed that the P.V. of the oil from the un-decorticated seed increased from 2.2 to 9.6 in 39 days while the oil from the decorticated seed increased from 2.2 to 9.4. Both oils lost part of the colour, and the smell after 39 days was blank.

EXPT. (3) EFFECT OF REMOVAL OF SESAMIN

50 Grams of sesame oil dissolved in 50 c.c. petrol ether (60-80° C.) was extracted repeatedly (10 times) with 20 c.c. portions of 90 per cent. acetic acid by shaking in the cold, the acid

layer being separated each time. The petrol ether portion was washed free from acid, the solvent removed by distillation under vacuum and the oil dried. Storage stability tests were carried out on part of this oil which was expected to be comparatively free from sesamin.²

During a period of 41 days P.V. increased from 5.1 to 11.2 and the oil lost part of its colour. Organoleptically the sample smelled good at the start, became blank after 15 days and continued to be so till the end.

EXPT. (4) EFFECT OF REMOVAL OF SESAMIN AND SESAMOL

The oil free of sesamin (Expt. 3) was cold extracted by shaking it with equal quantities of alcohol repeatedly (12 times) to remove sesamol⁶ and any fatty acids. The oil freed of the solvent under vacuum was examined for storage stability with results as given in Table I.

TABLE I

Storage time in days	Peroxide values	Organoleptic condition	Appearance
0	12.9	Very good	Light yellow
6	25.7		
11	77.3	Blank	
15	175.3	Rancid	White, clear, transparent
18	262.0	"	" viscous
21	314.7	"	" "
24	439.4	"	" "
28	537.9	"	" "
33	724.6	"	" very viscous
38	729.5	"	" "

EXPT. (5) EFFECT OF TREATMENT OF SESAMIN AND SESAMOL-FREE OIL WITH CALCINED ALUMINA

After the alcohol treatment in Expt. 4, the rest of the oil, which may now be expected to be free from sesamin and sesamol was taken up in petrol ether and shaken with an excess of specially prepared tested alumina with a view to remove any vitamins⁷ as also most of the residual colouring matter. The alumina was prepared by calcining pure aluminium hydroxide at 700° C. in an electric furnace for one hour. The oil, freed of the solvent and calcined alumina, was examined for storage sta-

bility. After 41 days, its peroxide value had gone up to only 29.1 from an initial value of 8.4. Organoleptically the oil smelled good at start and became blank after 41 days with no smell of rancidity. The colour, which was light yellow at start, became lighter after 15 days and was nearly bleached at the end.

EXPT. (6) EFFECT OF TREATMENT WITH
BONE CHAR

The oil obtained in Expt. 5 after treatment with calcined alumina was treated in petroleum ether solution with bone charcoal for 6 hours, filtered, freed of the solvent and dried under vacuum. The oil which was very faintly yellow and free from odour was tested for storage stability as before with results as given below:

TABLE II

Storage time in days	0	6	11	15	18	21	24	28	33	38	41
Peroxide value	5.8	22.2	47.5	67.4	82.6	105	121	157	227	364	307

DISCUSSION

With the removal of sesamol by means of alcohol in Expt. 4 the oil shows marked deterioration in stability which confirms the findings of H. A. Mattil³ that sesamol has antioxidant properties.

The subsequent treatment with calcined alumina was intended to remove any vitamins left in the oil⁷ in addition to removing most of the residual colouring matter. Thus, as a result of the first three treatments, the sesame oil would be free to a great extent from mucilaginous matter, sesamin, sesamol, vitamins, colouring matter and odoriferous compounds. One would have expected that with this treatment with calcined alumina the oil would have further deteriorated. But surprisingly enough, this is not the case and the oil shows a remarkable recovery. In this connection it may be noted that the calcination was done at 700°C. in an electric furnace on chemically pure aluminium hydroxide, a temperature at which complete

conversion to alumina takes place. One possible explanation for this interesting phenomenon is that the treatment besides taking away the vitamins has also removed any pro-oxidants existing in the oil. But if this were so, then the subsequent treatment with bone charcoal should have further improved its stability since bone charcoal is a good adsorbent. Actually this is not the case and the oil deteriorates quickly.

The work done also confirms the observation made by the authors⁴ and others during recent times that under normal conditions of exposure to air and light, the peroxide value does not always correlate with organoleptic rancidity. Thus the oil sample had no rancid smell up to a peroxide value of 175.3 in Table I and 364 in

Table II, while in other cases (unpublished data) under similar conditions of exposure to air and light, the smell of rancidity has been noticed at very much lower levels of peroxide value.

ACKNOWLEDGEMENT

One of us (N. H. Harkare) wishes to thank the Laxminarayan Institute of Technology for the award of a Research Scholarship.

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LADY TATA MEMORIAL TRUST—SCIENTIFIC RESEARCH SCHOLARSHIPS, 1951-52

THE Trustees of the Lady Tata Memorial Trust are offering six scholarships of Rs. 250 each per month for the year 1951-52 commencing from 1st July 1951. Applicants must be of Indian nationality and Graduates in Medicine or Science of a recognised University. The scholarships are tenable in India only and the holders must undertake to work whole-time under the direction of the head of a scientific department in a recognised research Institute

or Laboratory on a subject of scientific investigation that must have a bearing either directly or indirectly on the alleviation of human suffering from disease. Applications must conform to the instructions drawn up by the Trustees. Candidates can obtain these instructions and other information they desire from the Secretary of the Lady Tata Memorial Trust, Bombay House, Bruce Street, Fort, Bombay 1.

595359

RAIN MAKING*

IN a freshly formed cloud the particles have a size of the order of a thousandth part of a millimetre and remain suspended in air. It was the general belief some years ago that cloud particles grow by continued condensation and coagulation with other drops while falling until it became sufficiently large to fall as a rain-drop. In 1933 Bergeron showed that a cloud was a colloidal suspension of water in air, an "aerosol", which will remain in this state of colloidal equilibrium until a sort of coagulation was released within it. Even when cloud tops go up to temperatures below freezing, they consist of a mixture of ice-particles and super-cooled water droplets.

By injecting pellets of dry ice (solid carbon dioxide) or silver iodide into a cloud, conditions may be created, which will cause a sudden coagulation of the cloud particles into rain-drops. Dry ice has temperatures of less than -75°C . so that a pellet of solid carbon dioxide falling through the cloud will cool a thin streak of air momentarily to such an extent that spontaneous ice-formation will take place in the cloud along this track. A pellet of dry ice about 1 cm. in diameter produces about a million ice nuclei in saturated air at about 20°C . A pellet of dry ice is thus able to set up a chain reaction throughout the cloud.

The latest experiments have shown that heavy rain may be obtained from a cumulus cloud by using a single pellet of dry ice shot into the cloud from a pistol to a horizontal

distance of 700 feet or more at a height of 1,000 or 2,000 feet above the freezing level. The heat generated by the freezing of the super-cooled water droplets greatly increases the turbulence and favours the start of a chain reaction.

By injecting silver iodide vapour from the base of a cloud, rain has been induced. In South Africa a cloud has been induced to rain by sprinkling water from the top.

The experiments on artificial rain are of considerable interest to India. During periods of weak monsoon or during a prolonged break in monsoon, scarcity of rains over certain areas is attended with disastrous results. It is not unusual during such periods to find cumulonimbus clouds forming and extending to considerable heights and dissipating away without producing any rain. The seeding of such clouds with dry ice may result in the production of rain which might save dying crops. The method may also be found useful during January to March when weak western disturbances pass across Northern India but cause insufficient winter rain.

One interesting application which has been thought of and made use of on a few occasions is to change the track of a cyclone. A cyclone has a definite structure and the quadrant in which rainfall occurs determines its direction of movement. There is a release of enormous amount of latent heat in that quadrant and consequently a fall of pressure. The cyclone moves in the direction of falling pressure. If therefore by seeding in another quadrant, a significant amount of rain is produced in that quadrant the direction of the cyclone will be changed.

* Abstract of the Twelfth Jagadish Chandra Bose Memorial Lecture, delivered by Dr. S. K. Banerji, till recently Director-General of Observatories, Govt. of India.

INDIGENOUS SUBSTITUTES FOR CORN STEEP LIQUOR—AN ESSENTIAL FORTIFYING AGENT FOR PENICILLIN PRODUCTION

IN connection with the Penicillin Factory, jointly sponsored by the Governments of India and Bombay, it is estimated that about 1,000 tons of corn steep liquor (50 per cent. of solids), have to be imported annually from America. This would cost the country some five to six lakhs of rupees, payable in hard currency.

Corn steep liquor is an essential fortifying agent which effects a fifty to hundred-fold increase in the yield of penicillin.

Researches on finding a suitable substitute for the corn steep liquor, conducted in the

Section of Fermentation Technology of the Indian Institute of Science during the last 12 months, have shown that there are a number of indigenous raw materials and trade wastes which can be processed to yield a product equal if not superior to the corn steep liquor. The washings from a lac factory now running to waste, after suitable treatment, have been found to constitute an equally potent substitute. The hydrolysates of the pupæ of the silkworm and aqueous extracts of germinated green gram, have been found to be definitely superior to the American product.

LETTERS TO THE EDITOR

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COMPRESSIBILITY AND COMPLEX FORMATION IN ELECTROLYTES

THE formation of definite complexes in mixtures of certain electrolytes is well known. Thus the formation of complex compounds between lead nitrate and alkali nitrates has been established by Nayar and Pande¹ who investigated various physical properties, such as viscosity, conductivity, freezing-point depression, and by Narasimhamurthy,² who investigated the Faraday rotation and magneto-optic anomaly. At the stoichiometric proportions corresponding to complexes existing in solution, maxima or minima appear in the curves exhibiting the variation in property with proportion of any one constituent. Since the compressibility of an electrolyte is, to a large extent, determined by the nature of the ions and the variation in properties of the solvent in the ionic vicinity, it might be expected to exhibit abnormalities when complexes are formed.

The compressibilities and their variation with concentration were estimated for the following mixtures of molar solutions, from a measurement of the ultrasonic velocities in these liquids: $Pb(NO_3)_2$ and KNO_3 , $Pb(NO_3)_2$ and NH_4NO_3 , $Pb(NO_3)_2$ and $NaNO_3$, $FeCl_3$ and KCl . The well-known Bachem-Heidemann³ method of secondary interferences was employed. Parallel light from a mercury arc traversed the liquid cell in which stationary waves were

formed between the quartz at the bottom and the liquid-air interface. The pattern, formed by the secondary interferences of the emergent beam was viewed by a travelling microscope, some 50 half wave lengths of the ultrasonic wave being directly measured. Frequencies were measured by a precision wave-meter. Excitation was kept at a minimum and temperature variations did not exceed $0.1^\circ C$.

Adiabatic compressibilities have been determined using the relation $\beta_{ad} = 1/v^2\rho$; v = ultrasonic velocity ρ = density of the liquid. The partial molar compressibility

$$\frac{\beta V - \beta_0 V_0}{n_2} \approx \frac{\partial}{\partial n_2} (\beta V) = \bar{K}_2$$

is plotted against the molfraction of any one component.

The curves in the accompanying figure show the presence of minima at the stoichiometric proportions corresponding to definite complexes in solution. Thus, for $Pb(NO_3)_2 \cdot KNO_3$ molar solution mixtures, the minima occur at molar concn. 50%, 66%, and 80% of KNO_3 , corresponding to complexes $Pb(NO_3)_2 \cdot KNO_3$, $Pb(NO_3)_2 \cdot 2KNO_3$, $Pb(NO_3)_2 \cdot 4KNO_3$, and for the other curves, to complexes $Pb(NO_3)_2 \cdot NH_4NO_3$; $Pb(NO_3)_2 \cdot 2NH_4NO_3$ and $FeCl_3 \cdot 2KCl$. The curve for $NaNO_3 - Pb(NO_3)_2$ mixtures shows no kink, revealing no complex formation. These observations confirm the results of Nayar and Pande, and of Narasimhamurthy.

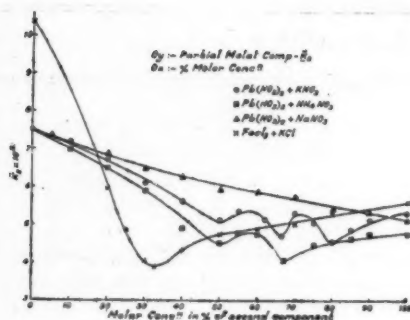


FIG. 1

A qualitative explanation of the observed variation of \bar{K}_2 is possible on the basis of the Debye-Huckel theory.⁴ The free energy of the solution of an electrolyte, expressed as the difference between that for concn. C and that for infinite dilution, is

$$F_2 - F_0 = \Sigma \nu_i RT \log c - \frac{A}{D^{3/2} T^{1/2}} (\Sigma \nu_i z_i^2)^{1/2} C^{1/2}$$

$A = \text{const.}$; $D = \text{dielectric const.}$, $\nu_i = \text{No. of ions, of charge } z_i \text{ per molecule.}$ The partial molal compressibility, is given by

$$-(\bar{K}_2 - K_0) = \frac{\partial^2}{\partial P^2} (F_2 - F_0)$$

and one obtains, $\bar{K}_2 - K_0 + f(D, P, V) (\Sigma \nu_i z_i^2)^{1/2} C^{1/2}$ the form of $f(D, P, V)$ is immaterial. (It is positive.) The cases investigated involve the formation of complex ions, such as $\text{Pb}(\text{NO}_3)_4$ (Glasstone and Saunders⁵). The consequent decrease in valence factor $(\Sigma \nu_i z_i^2)^{1/2} K_{23}$ and ionic density are seen to involve a decrease in actually observed, especially for the concentrations at which complex formation is predominant.

I thank Prof. R. S. Krishnan for valuable guidance and suggestions.

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November 27, 1950.

POLARISATION OF BRILLOUIN COMPONENTS IN LIGHT-SCATTERING IN LIQUIDS

ACCORDING to Brillouin's theory¹ of light-scattering in solids, scattering is, in effect, a coherent modified reflection of mono-chromatic light by a moving-mirror pattern in depth of density-fluctuations in the medium. The Doppler-shifted components of slightly altered frequency arising from such reflections should be perfectly polarised in the transverse direction. Sharp and well-defined Brillouin components are observed in light scattered by liquids

also; but my studies² have shown that they are highly, but not completely polarised. This observation has been confirmed by Bai³ and recently by Rank and his co-workers.⁴ I give below an explanation of this small, but finite percentage of depolarisation of the Brillouin components in liquids.

Frenkel's "hole theory" of liquids⁵ indicates two types of longitudinal sound waves in liquids, namely, (1) due to a purely translational vibration of molecules about their quasi-permanent equilibrium position, and (2) due to a translational accompaniment of angular vibration about the centre of gravity of the molecules. The first gives rise to longitudinal sound waves, in accordance with Brillouin's theory, causing density fluctuations in the medium. The predominant part of the transversely scattered light is due to these waves which satisfy the Bragg condition and constitutes the completely polarised portion of the Brillouin components. The second type of vibrations is also organised as the first and gives rise to two kinds of elastic waves, namely, (1) the longitudinal or 'l_a' waves, and (2) the transverse or 't_a' waves. If the molecules are anisotropic, both of them will give rise to Brillouin scattering with change of frequency; but this being part of the anisotropic scattering, will be depolarised to the limit. The scattering due to 't_a' waves is stronger of the two and evidence for both. The superposition of this weak scattering has been given by me in a recent note.⁶ The scattering by 'l_a' waves will be comparatively feeble and should have the same Doppler-shift of frequency as the purely translational component, as the velocity is the same for both. The superposition of this weak depolarised component on the strong 'density' component makes the latter feebly depolarised. A re-examination of my plates shows that the imperfection of polarisation of the components is more marked in liquids like benzene and tetralin, which possess a large depolarisation ratio. This gives support to the above conclusion.

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KAEMMERERITE FROM HULIKERE MINES, HASSAN DISTRICT, MYSORE

DURING the course of a visit to Hulikere Chromite Mines, near Jambur, Hassan District, an attractive flaky mineral was seen associated with chromite. This was at first sight mistaken for talc; but on detailed study, it is seen to be the chrome-bearing variety of chlorite, viz., K  mmererite. This variety has not been reported so far in India, except for a casual mention of its occurrence in the ultrabasic rocks of Chatnahalli, Mysore District, by Sri. M. G. C. Naidu, in the thesis submitted for M.Sc. Degree. The mineral shows a shining lavender colour, with a micaceous habit, coating the surface of the black ore. Under the microscope, the mineral appears as thin flakes, showing deep colours, due to high dispersion, surrounding the opaque ore-material. No constant relationship is observed between the quantity of chlorite under study, and the relative amount of opaque mineral.

The following statement shows the optical characters of this mineral in comparison with other K  mmererites reported so far:—

K��mmererite reported by A. N. Winchell ¹	K��mmererite reported by E. V. Shannon ²	K��mmererite under study
Optically positive 2V=Very small	Optically Negative 2V=Very small	Optically Negative Biaxial with very low optic axial angle inclining to almost uniaxial
Ng=1.509 Nm=? Np=1.586	Ng=Nm=1.590 Np=1.587	Ng=1.575 Nm=? Np=1.570
Ng-Np=0.004	Ng-Np=0.003 X=Pale red purple Y=Z=Red purple	Ng-Np=0.005 X=Pale pink Y=Z=Pale reddish yellow

A. N. Winchell³ has expressed the view that chlorites containing chromium in any important amount replacing aluminium are easily recognised by their lavender or violet colour. M. F. Heddle⁴ and Kopetzky⁵ in analysing different samples of k  mmererite have indicated the presence of 5.97 p.c. and 7.49 p.c. of chromium oxide respectively, which is totally absent in the common chlorites.

The sample under study was kindly analysed chemically by Sri. S. Venkata Rao and Sri. T. L. Kasturirangacharya, Department of Chemistry, Central College, Bangalore, and the analysis showed the presence of 7.06% Cr₂O₃.

Further, in its mode of occurrence and characteristic association with chromite ore and serpentine in the form of thin flakes, the mineral strongly resembles the k  mmererite of Shetland Islands, reported by Frank Phillips.⁶

The mineral has, therefore, been identified as k  mmererite.

The author is indebted to Prof. L. Rama Rao, Dr. C. S. Pichamuthu and Sri. M. G. C. Naidu for their encouragement and guidance.

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MIXED ADSORPTION OF HYDROGEN AND NITROGEN AT ELEVATED PRESSURES ON A PROMOTED IRON SYNTHETIC AMMONIA CATALYST

FOR correlating adsorption with catalytic activity, the study of adsorption from a mixture of the gaseous reactants is likely to be more fruitful than the individual adsorption data of the constituent gases. So far, very little work has been carried out in the field of mixed adsorption, especially on catalytically active adsorbents, although the immense importance of this type of study has been recognised by several authors.^{1,2} This is mainly due to the complicated nature of the theory of mixed adsorption. Ghosh, Sastri and Kini^{3,4} studied the simultaneous adsorption of carbon monoxide and hydrogen from mixtures of the two gases on two Fischer-Tropsch catalysts. Emmett and Brunauer⁵ measured the adsorption of nitrogen on the doubly promoted catalyst 931, from a 3H₂ + 1N₂ mixture, at pressures upto 50 atmospheres and at 450° C., employing an indirect method. At this temperature, synthesis of ammonia was found to occur to an appreciable extent. They reported that, at equivalent pressures, the adsorption of nitrogen from the mixture was the same as that from the pure gas.

It was considered desirable to investigate the mixed adsorption of these gases at temperatures below that required for appreciable formation of ammonia. When the Fe—K₂O—Al₂O₃—TiO₂ catalyst, on which the adsorptions

of hydrogen⁶ and nitrogen⁷ had been previously determined, was exposed for several hours to the synthesis gas at 50 atmospheres and at temperatures upto 350° C., no trace of ammonia could be found on releasing the whole of the gas in the system through Nessler's Reagent. The individual adsorptions of hydrogen and nitrogen from a 3:1 mixture have, therefore, been studied on the same catalyst at six temperatures between 50° and 350° C. and at mixed pressures upto 50 atmospheres, employing the improved technique developed by the present authors.⁶

The results obtained indicate that, while the adsorption of hydrogen from the mixture increases regularly with its partial pressure at all the temperatures studied, that of nitrogen shows this regularity only at the highest temperature, viz., 350° C. In practically every case, the adsorption of hydrogen at a given partial pressure from the mixture is considerably higher than that from the pure gas at an equivalent pressure. Similarly, except at two temperatures, viz., 203° and 300° C., nitrogen adsorption is enhanced in the presence of hydrogen. These results are at variance with those of Brunauer and Emmett⁸ who reported that the pre-adsorption of nitrogen at about 400° C. caused an enhancement of hydrogen-adsorption only on the alumina-promoted catalyst 954 and attributed the effect to the formation of imide and amide complexes. On the doubly promoted catalyst 931, they observed that the chemisorption of nitrogen inhibited almost atom for atom the chemisorption of hydrogen at 100° C.

At 350° C., certain interesting results are obtained which, probably reflect a fundamental variation in the nature of the phenomenon as the reaction temperature is approached. It is found that, when the partial pressure of nitrogen exceeds about 7 atmospheres, the ratio of the respective increments of nitrogen and hydrogen adsorptions varies successively from 1N₂ : 1H₂, through 1N₂ : 2H₂, to finally 1N₂ : 3H₂. This observation suggests the successive formation of =NH, -NH₂ and NH₃ complexes on the active surface of the catalyst.

Finding no evidence of complex formation on the active doubly promoted catalyst 931 at 100° C., Brunauer and Emmett⁸ suggested that the formation of such complexes had a poisoning effect on the synthesis. The present investigation, especially the results obtained at 350° C., on the contrary, lead one to the view that the NH and NH₂ complexes act much rather as natural intermediates and precursors of the

ammonia molecule ultimately formed on, and desorbed from, the surface. The latter view is substantially in agreement with the mechanism originally postulated by Frankenburg^{9,10} and by Emmett¹¹ as well.

The authors are grateful to Sir Jnan Chandra Ghosh and Prof. B. Sanjiva Rao for their kind interest and encouragement.

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PURIFICATION OF MUSTARD OIL CONTAMINATED WITH ARGEMONE OIL

CONTAMINATION of mustard oil with argemone oil and its effect on the incidence of epidemic dropsy¹ has been known for some time.

Roy² has recently published a method in which the removal of toxic alkaloids has been effected by treatment of the oil with phosphoric acid and subsequent removal of excess phosphoric acid with lime. Sen Gupta and Nair³ have tried to purify the oil by treatment with Fuller's earth at 60° C. for about one hour while agitating the oil by blowing air through it. The following simple method effectively removes the toxic alkaloids from contaminated mustard oil. The oil is stirred vigorously with a 20 per cent. solution of ferric chloride for about 20 minutes. The resulting emulsion is kept on a water-bath for half an hour and then allowed to settle for about two hours. The supernatant oil which could be filtered off is free from argemone oil as tested by the modified ferric chloride test.⁴ 20 per cent. of ferric chloride solution to the extent of 10 per cent. on the weight of oil is found to be sufficient for oils containing up to 5 per cent. of argemone oil. A further treatment of oil with about ½ per cent. of Fuller's earth may be used with advantage to improve the colour of the oil and ensures freedom from any traces of ferric chloride left behind. The

characteristics of the purified oil are not affected by the treatment.

A detailed paper on the work will be published shortly.

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INHERITANCE OF 'PISTILLATE' IN COTTON

'Pistillate'—a new character in desi cotton—was reported and described as one different from the 'petalody'.³ It was an interesting case of unisexuality of the male sterile type possessing staminode structures, branched stigma and fluted ovary. The type set normal bolls when dusted with foreign pollen and was being maintained by recovering the mutant in alternate generations. The genetics of 'pistillate' were studied at Coimbatore by crossing with two normal types, viz., 1274 and CST.3.

The normal was fully dominant and the segregation in F₂ was simple in cross with 1274. The other type CST.3 was a green stem/ghost¹ carrying the anthocyanin gene R_2^{as} . A two factor segregation for 'pistillate' and "ghost" with independent assortment of 27, 5, 10 and 2 plants under the four respective phenotypes, R_2^{as} normal, R_2^{as} pistillate, R_2^{as} normal and R_2^{as} pistillate, and a good fit for 9:3:3:1 dihybrid ratio were recorded in the second generation.

This new monogenic recessive in *G. arboreum* is assigned the gene symbol pte.

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POLARITY OF MALE CELLS IN POLLEN GRAINS OF SOME UMBELLIFERAE

The pollen grains of *Coriandrum sativum* L., *Cuminum cyminum* L., *Daucus carota* L., *Foeniculum vulgare* Mill., *Heracleum candicans* Wall., *Peucedanum graveolens* Benth., *Pimpinella diversifolia* D.C., and *Seseli indicum* W.A.,

were studied from acetocarmine preparations, cleared with chloral hydrate (Maheshwari and Wulff¹), and made permanent by the McClintock method.²

The young microspore is usually pear-shaped. At maturity, it becomes ellipsoidal with three germ pores at the equatorial region. Its nucleus lies towards one end where it divides, in a line with the longitudinal axis of the pollen grain, to form a faintly stained tube nucleus and brightly stained generative nucleus. The latter soon elongates and organises a thin sheath of hyaline cytoplasm. In *Coriandrum sativum*, *Pimpinella diversifolia* and *Seseli indicum* the generative cell mostly divides at one end of the pollen grain, whereas in *Cuminum cyminum*, *Daucus carota*, *Foeniculum vulgare*, *Heracleum candicans* and *Peucedanum graveolens* it moves to the equatorial region and divides there to form two sperm cells.

Sperm cells of the above-mentioned plants are elongated but variable in the length and shape of their ends, which may be blunt or pointed in different species. In *Coriandrum sativum*, *Daucus carota* and *Peucedanum graveolens*, one end of the male cell is pointed while the other blunt; in *Foeniculum vulgare* both ends are pointed and finally in *Heracleum candicans*, *Pimpinella diversifolia* and *Seseli indicum* both ends of a sperm cell are blunt. In the last three cases the pollen grains settle in such a position that the sperm cells mostly lie perpendicular to the surface of the slide, so that only one of the blunt ends is visible, whose circular outline is liable to be mistaken for a round nucleus.

The sperm cells, soon after their formation, begin to move apart towards opposite poles. A mature pollen grain, which is three-celled, thus has a round tube nucleus at the equatorial region and two elongated sperm cells lying one at each pole, showing a fixed polarity.

My sincere thanks are due to Dr. Maheshwari for his valuable suggestions and Dr. Bahadur Singh for his kind guidance.

Dept. of Botany, R. L. PALIWAL.
B. R. College, Agra,
August 1950.

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TEMPERATURE AS A SELECTIVE FACTOR FOR YEAST MUTANTS

YEASTS appear to be highly suitable for investigations on the mutagenic action of physical¹ as well as chemical² agencies. The two chromosome brewery yeast,³ BY 1, shows a seasonal variation in the predominance of the

various gene mutants.⁴ For any accurate work on the evaluation of the mutagenic property of various agencies the prime consideration is the genetic purity of the material.⁵ The very short generation time of the two chromosome strain results in the quick appearance of the mutants, even though the rate of mutation in yeasts may be identical with that in higher organisms. To get a pure culture for any specific genic constitution either the mutational step should be inhibited by some agency⁶ or the environment should be used as a selective factor.

Mallya and Subramaniam⁷ demonstrated that strains having different genic constitutions show different rates of growth under identical conditions. When grown at room temperature there is a regular sequence in the appearance of the mutants. The above observations suggested the possibility that by con-

evidenced by the *Smooth* sector seen on the right-hand side of the colony in Photo 1. But the shape of the sector indicates that the cells composing it have an inferior rate of growth. In Photo 2 (cf. 4 Photo 10) on the other hand, the four *smooth* sectors start almost from the centre of the colony. The obvious conclusion is that the particular temperature conditions form only a selective environment but do not inhibit the mutational step. The control run at room temperature gave the giant colony presented as Photo 3. Each allelic combination may have a specific temperature optimum^{9,10} above or below which its proper functioning may be altered considerably.¹¹

The observations recorded above suggest that the optimum temperature for the growth of the *Rough II* type of mutant is between 30-31° C. Naturally the *Rough II* cells would be inferior

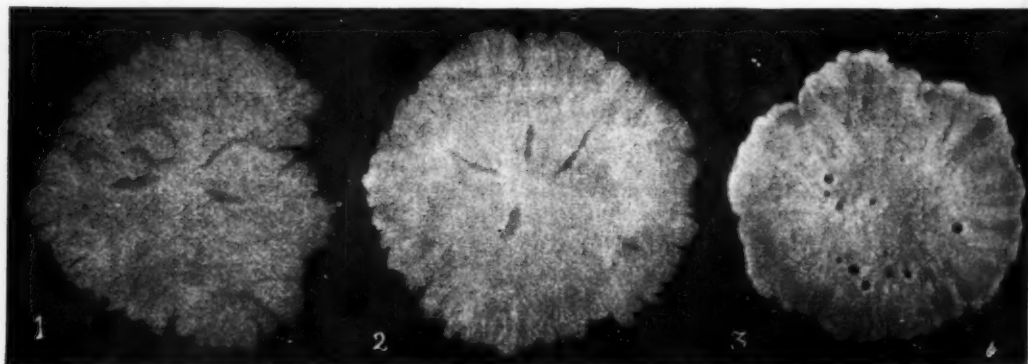


Photo. 1. BY 1, Barley Malt, 5.0 cm 17 day growth, 31°C. photographed on 30-9-1949.

Photo. 2. BY 1, Barley Malt, 5.5 cm. 17 day growth, 31°C. 30-9-1949.

Photo. 3. BY 1, Barley Malt, 2.6 cm. 15 day growth, room temperature, 28-9-1949.

trolling the temperature, specific types could be isolated and kept unchanged.

Culture of the two chromosomes strain were grown continuously in wort in an incubator at a temperature of 30-31° C. Giant colony inoculations were carried out at periodic intervals and the giant colonies themselves were grown at the above temperature. While at room temperature the diameter of the colonies was only ca. 4.0 cm,⁸ their size ranged from 5-6 cm. when grown at 31° C. Naturally, the final expression of the sculpturing in such colonies was dependent on the depth of the medium in the petri dish and the sample of malt employed. Under ideal conditions, the colonies which developed were of the *Rough II* type (Photo 1) having the genic constitution *Rough/Rough*.⁴ The temperature inside the incubator (31° C.) has, therefore, acted as a selective environment for the *Rough II* type. Mutations do occur as

in their growth-rate⁷ to the other types at temperatures above or below this optimum.

Cytogenetics Lab., S. N. KRISHNA MURTHY.
Ind. Inst. of Science M. K. SUBRAMANIAM,
Bangalore-3,
October 18, 1950.

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PHOTOPERIODIC STUDIES IN INDIAN
VEGETABLESII. *Amaranthus gangeticus* var. *oleraceus*
Roxb.

Of the few species of *Amaranthus* studied photoperiodically, Allard and Garner (1940) reported *A. hybridus* and *A. sp. Dreersunrise* as indeterminate ones and Fuller (1949)¹ classified *A. caudatus* L. as a short day species. Samantarai and Panigrahi report that *A. gangeticus* var. *tristis* is also a short day species.

In the present work, photoperiodic response of *Amaranthus gangeticus* var. *oleraceus* to varying periods of illumination is reported. Plants were grown in earthenware pots of 6" × 10" and the soil consisted of silt and farmyard manure in proportions of 2 : 1. The seeds

"Phillips" bulb kept at a distance of 5' from the growing apices of plants till April 30, when the experiment terminated.

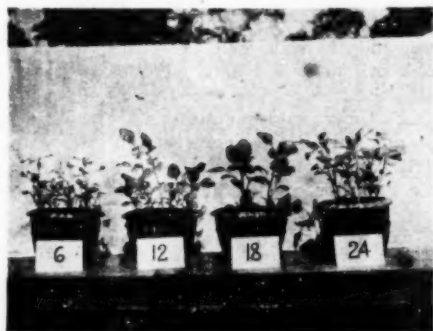
Table I shows the vegetative characters and periods of flowering in plants receiving varying periods of illumination.

CONCLUSION:—*Amaranthus gangeticus* var. *oleraceus* is distinctly a short day species. Even 12 hours daily exposure is sufficient to render the plant vegetative, although *Amaranthus gangeticus* var. *tristis* flowers copiously under identical conditions.² The plants show the best vegetative growth under 18 hours daily exposure but under continuous illumination they have no apical dominance and the leaves are shrivelled and hence this is not conducive for good vegetative growth.

TABLE I

Nature of treatment	No. of days taken for flower bud formation from the date of sowing	Length per plant in cm.		No. of leaves per plant	Weight per 100 plants in grams			
		Root	Stem		Fresh weight		Dry weight	
					Root	Stem	Root	Stem
6 hours (9 a.m.-3 p.m.)	32	10.6	15.4	20	14.8	191	5	20
12 hours	.. vegetative throughout	11.5	16.1	21	37.5	234	8.3	23
18 hours	.. do do	12.7	18.5	25	85.5	662.5	18.5	181
24 hours	.. do do	12.6	17.9	21	70.4	652.7	16.2	171.5
Control	.. 39	15.5	13.4	23	190	405.4	42.3	102.7

were sown on February 10, 1950, at 8 a.m. and the pots were divided into 5 groups of 4 each, ten plants growing per pot. Periods of illumination consisted of 0, 6, 12, 18, 24 hours and



control. Daylight was the main source of light and wherever necessary, it was supplemented by electric light from a 1,000-watt

Grateful thanks are due to Dr. B. Samantarai, Head of the Department of Botany, Ravenshaw College, Cuttack, for his encouragement and guidance.

Botany Dept.,
Ravenshaw College,
Cuttack,
October 28, 1950.

GOPINATH PANIGRAHI.

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HYDROLYSED FERRIC SALT AS
BETTER FLOCCULATING AGENT

FERRIC SALTS in solution undergo hydrolysis, which is directly proportional to the temperature and time and inversely proportional to the concentration of the ferric ions (Jacques and Lamb¹). If this hydrolysed solution of ferric salt is used for coagulating the negatively-charged antimony sulphide sol, it is observed

TABLE I

Normality of FeCl_3	0.00535	0.0107	0.0214	0.0412	0.107	0.124
Coagulation value at 0 hr.	7.8 c.c.	6.5 c.c.	6.0 c.c.	5.8 c.c.	5.5 c.c.	5.0 c.c.
Coagulation value at 2 hrs. of hydrolysis	5.6 c.c.	4.9 c.c.	4.2 c.c.	4.0 c.c.	3.6 c.c.	3.4 c.c.

that a lower amount of the hydrolysed salt is required for coagulation as compared with that of an unhydrolysed sample of the ferric salt. Results obtained with ferric chloride are given in Table I. The time of hydrolysis is 2 hours and the temperature 60°C . Coagulation values have been obtained by finding out the amount of ferric chloride necessary to obtain a standard turbidity in 2 c.c. of an antimony sulphide sol.

Similar results are obtained with the nitrate, sulphate and alum of iron.

Ferric hydroxide formed by hydrolysis is stabilised by the adsorption of positive ions, forming the more powerfully coagulating colloidal ferric hydroxide. The coagulation values obtained with the negatively-charged antimony sulphide sol, therefore, go on decreasing as the hydrolysis proceeds. It appears that the use of iron in a colloidal state is more suitable and economical than its use in the ionic form, wherever it has to function as a flocculating agent. Further work in this subject is in progress.

Chemistry Department, P. M. BARVE.
Wilson College, A. K. JAMBOTKAR.
Bombay-7,
November 20, 1950.

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BACTERIAL LEAF-SPOT OF CASTOR

A SEVERE bacterial leaf-spot of castor (*Ricinus communis* L.) similar to that reported by Yoshi and Takimoto (1928)¹ from Japan and Korea and by Hansford (1935)² from Uganda was observed at Anand, Dist. Kaira in December, 1949.

On the leaves, the pathogen produces few to numerous, small round, water-soaked spots measuring initially 0.5 to 1 mm., mostly aggregated towards the tip. Some of them increase in size (2 to 3 mm.), become angular and dark-brown to jet black. On the other hand, the undeveloped spots remain circular with pale-centre and dark-margins. When coalescent, spots become irregular in shape, the areas around such spots turn pale-brown and brittle. Bacterial ooze in the form of small shining beads or fine scales is found on both sides of the spot which get depressed on the under-surface of the leaves; the corresponding areas

on the upper surface are raised and present a pale-white appearance due to bacterial exudation. The pathogen infects cotyledons, leaves and veins.

Description of the pathogen:—Short rods; single or in chains; $1.5 \times 0.7 \mu$; Gram negative; capsulated; no spores; on potato dextrose agar, the colonies are circular with lobate margins, smooth, shining, convex, with striations at the periphery, measuring 1.2 cm. in diameter after 7 days; colour marguerite yellow; gelation liquefied; starch hydrolysed; casein digested; milk peptonised; litmus reduced; ammonia and hydrogen sulphide produced; nitrates not reduced; acid but no gas in dextrose, sucrose and lactose; no growth in salicin; optimum temperature for growth 31°C .; thermal death point about 51°C .; pathogenic on castor.

The disease is similar to that caused by *Xanthomonas ricinicola* (Elliott) Dowson.

Plant Path. Lab., M. K. PATEL.
Agric. Coll., Poona, Y. S. KULKARNI.
July 30, 1950. G. W. DHANDE.

I. Yoshi, H. and Takimoto, S., *J. Pl. Protect.*, 1928 (Tokyo), **15**, 12-18. 2. Hansford, C. G., *E. Afr. Agric. Farm.*, 1935, **1**, 25.

THE REFLECTANCE SPECTRUM OF IGNITED SOILS AS AN INDICATION OF THE MINERALOGICAL COMPOSITION OF THEIR CLAYS

RAMAMOORTHY and Viswanath¹ have studied the reflectance spectra of black, red, yellow and grey soils both before and after ignition at 500°C . Nagelschmidt, Desai and Muir² have shown that the dominant clay minerals in the black and red soils from India are those of the montmorillonite and kaolin groups respectively. Nagelschmidt³ reports from X-ray and thermal studies that clay minerals of the kaolin group undergo lattice destruction and break down at 500°C ., while those of the montmorillonite-mica group are quite stable upto 800°C . or even more. Thus, the particles of the inorganic colloidal stains spread on the soil skeleton in the red soils should disintegrate on ignition at moderate temperatures, while those in the black soils need not do so. Puri,⁴ on the other hand, has shown that on ignition, the black soils have their clay complexes built into bigger aggregates by condensation of the hydroxyl groups. It should be possible, therefore, to differentiate

the dominant clay mineral of those soils by the mere reduction or increase on ignition in the particle size of the colloidal stains, which can be judged from the reflectance spectra of the soils by applying the laws of light scattering.

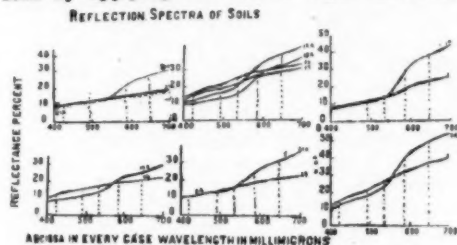


FIG. 1

Fig. 1 gives the reflectance spectra of natural and ignited soils obtained on a G.E.C. self-recording photoelectric spectrophotometer by the method reported by us.¹ Curves marked by a number refer to the natural soil and those

clay, while Dacca (7) and Taliparamba (1) with big slopes or smaller number of bigger aggregates have kaolin group dominating the clay. These results from the reflectance curves are in accordance with the base exchange capacity per 100 gm. of clay of different clay minerals and are in conformity with the observations of Nagelschmidt, Desai and Muir² from X-ray studies on the distribution of montmorillonite and kaolin in Indian soils. Hariipurhazara (12) and Lyallpur (15) soils have intermediate values of the steep. That this is due to dominance of the mica group in these soils and not to a mixture of the montmorillonite with a member of the kaolin group is shown by the greatest depression on ignition in the violet reflectance, which cannot be explained if it were a mixture of the above two types. This view is supported by the low percentages of clay-K and clay-Mg, that are in the exchangeable form which are characteristic of the mica group.

TABLE I

Ref. No. on curves (Fig. 1)	Soil from	Colour of the soil	% Reflectance at violet end	Max. slope of curve in degrees	% Reflectance at red end	Wave length at which max. slope occurs	B.E. Capacity in m.e. per 100 gr. clay
21	Padegon Natural	Black	8.7	8	17.5	0.495 μ	89
21A	Padegon Ignited		8.0	36	29.5	0.54	
19	Powerkhara Natural	-do-	11.0	9	21.2	0.4825	85
19A	Powerkhara Ignited		8.5	31	28.5	0.54	
1	Taliparamba Natural	Red lateritic	8.0	25 $\frac{1}{2}$	25.0	0.54	31
1A	Taliparamba Ignited		7.5	54	43.8	0.55	
7	Dacca Natural	-do-	13.0	27 $\frac{1}{2}$	40.5	0.495	38
7A	Dacca Ignited	yellow	11.5	57	54	0.545	
12	Hariipurhazara Natural	Gray	14.0	21	32.5	0.49	73
12A	Hariipurhazara Ignited		11.5	45	43 $\frac{1}{2}$	0.54	
15	Lyallpur Natural	Pinkish grey	13.0	18 $\frac{1}{2}$	30.0	0.51	72
15A	Lyallpur Ignited		9.7	42	32.0	0.55	

with the letter 'A' added refer to the ignited soil. The ordinates are the percentage reflectance and the abscissa are the wavelength in millimicrons, and are cut by the dotted vertical lines into six colours of the visible spectrum (violet, blue, green, yellow, orange and red). The derived data are presented in Table I.

According to Gampel and Barnet,⁵ the greater steep is associated with finer particle size and the particles are more monodispersed, than when the steep is less, with less reflectance in the red end. This shows that Padegon (21) and Powerkhara (19) soils on ignition have small slope of 31-36° and therefore a larger number of bigger aggregates indicating montmorillonite group as dominating their

Further details and interpretation of the reflectance curves will appear elsewhere. This method appears to provide a quick characterisation of clays and might be of interest both in soil science and ceramic industry.

8A/85, W.E. Area,
Pusa Road, New Delhi-5.
Ind. Agril. Res. Inst.,
New Delhi,
November 19, 1950.

B. VISWANATH.

B. RAMA MOORTHY.

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REVIEWS

Atomic Physics. By J. B. Rajam, S.J., Head of the Dept. of Physics, St. Joseph's College, Trichinopoly, 1950. Pp. 1,056.

This is a welcome addition to the very small number of books by Indian authors on advanced Physics. The book, consisting of over 1,000 pages, is divided into three main parts. The first deals with the electron, positive rays, X-rays and radio-activity; the second, with relativity and the wave nature of matter and the third with spectra, cosmic rays and the nucleus.

The book, according to the author, is mainly intended for the pass and honours students. He rightly admits that while this contains more than what is needed for the pass student, it does not cover fully the honours syllabus. Owing, however, to the almost semi-popular exposition, which does not take much for granted, the book would also prove extremely useful to persons of a fairly good general education, particularly in these days when the atom bomb has aroused the interest of the educated public in nuclear physics to which the author has devoted a considerable part of the book.

It must, however, be pointed out that the photographs of the great men of Physics have room for considerable improvement. Again the graphical representations have not been prepared with the attention they deserve. For instance, the Bohr-Coster diagram for the limits of the K- and L- series are practically parallel to one another. Statements like "there is a certain critical distance within which it (the Coulombian law of force) fails" or "ceases" on p. 973, or "it (neutrino) is more akin to a photon than to a material particle" on p. 688 or again "the n-n and p-p attractive forces, if they exist, are . . . vanishingly small" on p. 1027 are not precise and may suitably be altered in subsequent editions.

The lack of even a very brief bibliography is rather a serious drawback in a book of this nature.

S. B. B.

Physical Chemistry of High Polymeric Systems. By H. Mark and A. V. Tobolsky. (Interscience Publishers, 215, IV Ave, New York), 1950. Pp. xi + 506. Price \$6.50.

All polymer chemists are fully familiar with the High Polymer series, at present running

into ten volumes, edited by Mark, Whitby and others. The new edition of Volume II of this series, after ten years of its original publications, makes it the only up-to-date book on the subject. In the new edition, Dr. Mark is assisted by Dr. Tobolsky, and there are additional 150 pages, 56 illustrations and 13 tables. A special feature of this edition is the inclusion of appropriate and helpful examples at the end of each chapter. The authors have very systematically put in between covers all the relevant information that is scattered in numerous publications during the last ten years.

The first seven chapters are devoted to the geometry and crystal structure of ordinary molecules and subsequently of macromolecules, together with a well-written description of molecular spectra and X-rays as tools for their evaluation. The next three chapters deal with the thermodynamics of polymer solutions where osmotic pressure and viscosity have been adequately discussed and a brief description of sedimentation and flow birefringence techniques as applied to macromolecules in solution is also given. The next chapter gives a brief description of the mechanical properties of high polymers and their relation to molecular structure. The last three chapters on kinetics and degradation of polymers are fresh additions to this edition and present more detailed information than the earlier chapters and include a thorough survey of the developments and progress in this important aspect of polymer chemistry.

The integrated picture of the physical chemistry of high polymers presented by the authors keeps even a casual reader interested throughout. Numerous references to pertinent original publications have been inserted for the interested reader. The paper and quality of printing are excellent.

S. L. KAPUR.

Apples and Apple Products. By R. M. Smock and A. M. Neubert. (Interscience Publishers), 1950. Pp. xvi + 486. Price \$7.80.

This is Volume II in the series of monographs on economic food crops designed to present a critical account of various factors, agricultural, physiological and chemical, influencing crop production and utilization. It is seldom that one gets information, within a single book, which is of value to chemists,

physiologists, botanists, nutritionists, and food manufacturers alike. Indeed, it has often been a rather common experience to find a lack of understanding of each other's problems in the different groups. Thus, on the one side, the requirements of the food processor are not always reckoned by those dealing with the various aspects of crop production while, on the other side, he probably evinces a lack of sufficient appreciation of the problems in the large-scale production of uniform crops of high quality.

It is for such reasons that an integrated discussion of the problems facing both groups has unusual practical value. The volume under review deals with the chemistry, physiology and processing of this one fruit, apple. While chemical composition and physiological behaviour are the central themes, the book also deals with botanical aspects and production factors as well as with detailed methods of utilization and processing. The various chapters in the book include: history and world distribution; tree and fruit characteristics; development and anatomy of mature fruit; physiology and composition of the developing and mature fruit, including treatments on enzymic and vitamin changes and influence on these of cultural and environmental factors; factors affecting fruit maturity, storage life and quality; preparation and preservation of apple products by drying, canning, and freezing; production of apple juice, syrup, and concentrate; fermented apple products; apple butter, jelly and other confections; and, finally, utilization of apple pomace. There are appendices giving production and utilization statistics and the book is throughout illustrated with photographs, flow diagrams, charts, data, and tabular statements. References have been cited to establish authority and to assist the reader who may wish to read more fully on any particular topic.

To deal with such a diversity of topics calls for a difficult task from the authors and this they have admirably succeeded in accomplishing.

A. SREENIVASAN.

Biological Studies with Polonium, Radium and Plutonium. Edited by R. M. Fink. (McGraw-Hill Book Co., Inc., New York). Pp. 441. Price. \$3.75.

Biological studies were carried out with polonium, radium and plutonium by Dr. Fink and his colleagues in the University of Rochester under the auspices of the Manhattan Project of the Atomic Energy Commission, and the volume under review is largely a report of their in-

vestigations along with a critical appraisal of the literature concerning the retention, distribution and toxicity of the three elements.

Dr. Fink has ably edited the large amount of valuable material by dividing it into eight chapters. The first three deal with the general methods used and the results obtained on polonium metabolism in rats, rabbits and in human subjects. The next three chapters relate to the distribution and excretion of radium beginning with a comprehensive survey of literature on radium metabolism. It is evident that in spite of the extensive use of radium, only few clear-cut and thorough quantitative experimental studies have so far been carried out on radium metabolism either in man or in the experimental animal. The last two chapters give details of toxicity studies on intravenous lethal dosage of polonium, plutonium and radium in rats. Preliminary experiments were first carried out to determine the approximate dosage values. It is interesting to note that the difference observed in their relative toxicities closely parallel those observed in the half lives, distribution in the body and rate of excretion of these three elements.

These biological studies, undertaken mostly in rats, even though of short duration, were carried out in the hope that these data taken in conjunction with known tolerance limits for radium and X-rays in man may prove to be of value in arriving at tolerance figures for polonium and plutonium. The results obtained constitute, therefore, an important contribution to our efforts in understanding the general problem of long-term human tolerance to a variety of radio-active materials, and the volume should prove invaluable to all those engaged either in the therapeutic application or fundamental investigation of radio-active isotopes.

P. S. SARMA.

Plant and Soil Water Relationships. By Paul J. Kramer, Professor of Botany, Duke University. (McGraw-Hill Book Co., Inc., N.Y.), 1949. Pp. xiii +347. Price \$4.50.

In any scheme of things that deal with tropical agriculture, two factors must be carefully considered, soil moisture and soil organic matter. Paul J. Kramer's book supplies the much wanted information on plant and soil water relationships in a precise and concise manner. It combines a discussion of soil moisture and the factors affecting its availability to plants, with a discussion of plant water relations. Considerable attention has been paid to the application of basic physical and physiological principles in explaining plant growth.

The various irrigation projects that are existing, those in execution and those being planned will have to make every drop of water that is collected do its duty if they are to prove efficient. For a planting industry mostly located in heavy rainfall areas, the problems are of a varying nature. During the heavy rain periods the soil is oversaturated and suffused with water, but during long periods following this rainy season drought occurs. Defoliation as a consequence of lack of drainage and poor re-foliation for lack of moisture are problems that are facing the coffee and tea industries respectively. Methods of soil management have to be devised after careful study of the conditions affecting the plants. This book supplies information required for planning such studies and should prove useful to all agriculturists in the country. Written in admirable style and covering eleven chapters running over nearly three hundred pages, it is a worthy addition to the series of excellent books published by Messrs. McGraw-Hill Book Company. As usual, a very select bibliography and a good subject and author index are placed at the end of the book.

N. G. C.

Java Tapioca, Its Manufacture, Grading and Use. By L. W. J. Holleman. (O.S.R. Publication 22).

This communication reviews the progress made in Java during the past few decades in the production of tapioca flour for industrial use. The methods of processing, collection from big as well as small producers, grading and testing have been discussed. The organisation has helped to maintain and offer to the overseas consumers, products of the desired quality. The production of tapioca in Java has been encouraged to the maximum possible extent, not only because of its export value but also in consideration of its utility as an article of human food, especially during seasons of rice shortage.

V. S.

Cell Physiology and Pharmacology. By J. F. Danielli. (Elsevier Publishing Co., Inc., New York), 1950. Pp. vi + 156. Price \$3.00.

One of the most fascinating and difficult field of pharmacological study is that which deals with the mechanism of drug action. The chief difficulty in the interpretation of the action of a drug lies in the lack of precise knowledge as to the actual site of drug action. Considerable experimental evidence has accumulated during recent years which shows that the biological activity of a drug depends on molecular interaction with the biological system involv-

ing differential solubility in the cell lipoids, adsorption at cell interfaces or more specifically polar interaction and specific stereo-chemical relationship of the reactants in the system.

Too little is known of cellular physiology to permit an interpretation of the mechanism of the action of drugs. The author has attempted to explain the physico-chemical principles involved in the reactions of organised matter. Discussing in Chapter I the cell as physico-chemical unit, he outlines the main aspects of the cytological background, and describes in some detail properties of the molecular types constituting the cell, viz., the unit of structure, control of enzyme systems, the dielectric properties, membrane properties and the dynamic condition of cell constituents. In subsequent chapters the author discusses the possible action of drugs on surfaces, membrane permeability and drug action, and enzymes and drug action. Attempting to explain the mechanism of the action of narcotics, the author discusses the theories of action upon surfaces, theories based on oil-water partition effects and theories based on action on enzymes. There are many apparent exceptions to such isolated principles.

In the concluding chapter on "Responses of the Cells on Biological Level", a few positive statements pertaining to the more general concepts of this subject have been made. A considerable number of drugs have been classed as mitotic poisons, and in the chemotherapy of cancer this particular aspect of mechanism of drug action has been most interesting. It has also been supposed that some drugs have their main action upon the cytoplasm, while others have their action on the nucleus; but the correctness of these hypotheses has not been definitely established especially with respect to the latter. Possible modes of drug action upon genes are still very complicated and no definite explanation is available.

The book is intended to direct the attention to the biologic aspect of drug action. Could we determine the relationship between the drug receptor group in the cell and the external drug phase, we should be in a much better position than we are at present to collaborate with the chemist in the synthesis of new compounds. The author's aim is to stimulate biological research on drug action with this end in view.

The book is of great value to the pharmacologists, chemists and biologists. It is a very stimulating contribution and is highly useful for research in biological field.

N. N. De.

SCIENCE NOTES AND NEWS

Royal Society Awards for 1950

The award of two Royal Medals for 1950—one to Sir Edward Appleton and the other to Dr. C. F. A. Pantin—has been announced by the Royal Society.

Sir Edward Appleton wins the award for his work on the transmission of electro-magnetic waves round the earth and for his investigations into the ionic state of the upper atmosphere. Dr. Pantin made a notable contribution to the comparative physiology of invertebrates.

Sir James Chadwick, Air Commodore Sir Frank Whittle, Sir John Shimonsen, Prof. F. E. Fritsch and Prof. M. Born are the recipients of the Copley, Rumford, Davy, Darwin and Hughes Medals respectively.

Award of Research Degrees

On the recommendation of the Board of Examiners consisting of Prof. H. W. Thompson, F.R.S., Prof. M. G. Evans, F.R.S. and Prof. S. R. Khastgir, D.Sc.; and Prof. R. W. Lunn, Prof. McKie and Prof. McBain, the Banaras University conferred the degree of Ph.D. on Messrs. B. B. Prasad and G. R. Phansalkar, for theses on "Joshi-effect in H.F. Conduction in Chlorine" and "Some Thermo-Chemical Studies", respectively.

Admission to Institutions in Trinidad

Indian students wishing to apply for admission to the Imperial College of Tropical Agriculture, Trinidad, West Indies, or to any other institution in that country are required to forward their applications to the Ministry of Education, Government of India, New Delhi, for onward transmission to the Indian Commissioner, Port of Spain, Trinidad. Applications for admission to the College should not be made to the High Commissioner for India in London.

Conference on Sugarcane

The First Biennial Conference of Sugarcane Research Workers will be held at Coimbatore from 9th to 12th January 1951, under the Presidentship of the Hon'ble Shri. M. Thirumala Rao, Deputy Minister for Food, Government of India.

Union Catalogue of Periodicals Available in South Asia

The pilot fascicule of the Union Catalogue of Periodical Publications with the holdings in

physics and chemistry available in the libraries of South Asia was issued by the middle of May, 1950. Copies of it were sent to many known libraries and experts in documentation and library science. Their new features are: (1) Subject classification of the entries; (2) Details about the changes in titles, etc.; (3) Class number to bring all related subjects together; (4) Numerical notation of the location of the libraries, consecutive numbers denoting adjacent areas.

The Union Catalogue will be maintained in cards and will be in the charge of the Delhi University Library so as to provide easy access to seekers and to facilitate replies being promptly sent to postal enquiries.

Indian Botanical Society

The following were duly elected as Office-bearers of the Indian Botanical Society for the year 1951:

President: Dr. P. Maheshwari, Delhi. *Vice-Presidents:* (1) Dr. S. P. Agharkar, Poona; (2) Dr. B. P. Pal, Delhi. *Hon'y. Secretary:* Dr. R. Misra, Sagar. *Treasurer:* Dr. R. L. Nirula, Nagpur. *Editor-in-Chief:* Dr. A. C. Joshi, Hoshiarpur. *Councillors:* (1) Dr. A. C. Joshi, Hoshiarpur; (2) Dr. T. S. Mahabale, Bombay; (3) Dr. Y. Bharadwaja, Banaras; (4) Dr. L. N. Rao, Bangalore; (5) Dr. I. Banerji, Calcutta; (6) Dr. G. P. Majumdar, Calcutta; (7) Mrs. E. Gonzalves, Dharwar; (8) Sri. M. B. Raizada, Dehra Dun; (9) Dr. P. N. Mehra, Amritsar; (10) Dr. R. K. Saxena, Allahabad. *Members of the Editorial Board:* (1) Dr. P. Maheshwari, Delhi; (2) Dr. B. P. Pal, New Delhi; (3) Dr. A. C. Joshi, Hoshiarpur; (4) Dr. P. Parija, Banaras. *Business Manager:* Dr. T. S. Mahabale, Bombay.

National Institute of Sciences of India

At the Anniversary General Meeting of the National Institute of Sciences of India held at Bangalore on the 1st January, 1951, the following were duly elected office-bearers and other members of the Council of the Institute for the year 1951:

President: Dr. S. L. Hora, Calcutta. *Vice-Presidents:* (1) Dr. K. S. Krishnan, Delhi; (2) Prof. P. Parija, Banaras. *Treasurer:* Dr. C. G. Pandit, Delhi. *Foreign Secretary:* Dr. J. N. Mukherjee, Delhi. *Secretaries:* (1) Prof. D. S. Kothari, Delhi; (2) Dr. H. S. Pruthi, Delhi,

Editor of Publications: Mr. J. M. Sen, Calcutta. **Members of Council:** Dr. S. P. Aghar-kar, Poona; Prof. K. N. Bahl, Lucknow; Dr. S. K. Banerji, Calcutta; Prof. H. J. Bhabha, Bombay; Prof. S. Bhagavantam, Hyderabad; Prof. B. B. Dey, Madras; Dr. B. C. Guha, Calcutta; Prof. A. C. Joshi, Hoshiarpur; Prof. R. C. Majumdar, Delhi; Dr. B. P. Pal, Delhi; Dr. V. G. Panse, Indore; Dr. Mata Prasad, Bombay; Dr. L. A. Ramdas, Poona; Prof. M. N. Saha, Calcutta; Prof. N. R. Sen, Calcutta; Dr. P. V. Sukhatme, Delhi; Dr. A. C. Ukil, Calcutta.

The following were elected Ordinary and Honorary Fellows of the Institute:

Ordinary Fellows: Prof. R. K. Asundi; Dr. K. P. Basu; Prof. K. P. Chattopadhyaya; Dr. C. R. Das Gupta; Dr. S. Ghosh; Lt.-Col. S. D. S. Greval; Mr. S. Gupta; Dr. P. V. K. Iyer; Mr. A. N. Khosla; Dr. K. B. Lal; Prof. Shri Ranjan; Prof. S. R. Narayan Rao; Mr. K. Sawhney; Prof. N. K. Sen; Sir M. Visvesvaraya.

Hony. Fellows: Sir Alexander Fleming, N.L. (England); Prof. Richard Kuhn, N.L. (Germany); Prof. Hermann Joseph Muller, N.L. (U.S.A.); Prof. Selman A. Waksman (U.S.A.).

Society of Plant Morphologists

During the recent Indian Science Congress Session held at the Indian Institute of Science, Bangalore, a group of Botanists interested in Plant Morphology met on January 4th, 1951 and decided to form a Society of Plant Morphologists. It was resolved that the Society must start a Journal devoted to all aspects of Plant Morphology from Algae to Angiosperms and run it on an International basis. It was unanimously agreed that the amount for Life Membership of the above Society should be Rs. 200 and the annual subscription Rs. 20. Pending formal election of office-bearers sometime next year it was arranged that Prof. P. Maheshwari, Professor of Botany of the Delhi University, Delhi 8, be requested to act as the Convener of the Society and Editor of the Journal. All interested in Plant Morphology are requested to join the Society and send the subscription to the Convener.

Indian Standards Institution

The Third Annual Report of the Indian Standards Institution which has just been

published reveals that during the year the Institution received increased support both from Government and industry. Its membership rose from 475 to 563 and the number of Committee Members went up from 1,600 to 2,200. The number of Sectional and Sub-Committees is reported to be nearly 240 as against 190 in the previous year.

Particular mention has been made in the report of the recommendation of the special committee on weights and measures and the scheme of certification marking now under consideration of the Government of India.

The certification marking scheme is a measure intended to encourage standardisation of industrial products, which should also convey to the consuming public a guarantee of quality in respect of goods to which the mark is applied. In this connection a draft Bill, which was earlier submitted to the Government of India, is now under consideration and it is expected to be introduced in the next session of Parliament.

Other subjects under consideration, cover a wide range of engineering, textile and chemical items including cement and concrete, ferrous and non-ferrous metals, electrical plant, conductors and accessories, timber, hardware, refractories, radio equipment, batteries, cotton yarn and cloth, jute, wool, textile stores, national flag, rayon, organic and inorganic heavy chemicals, fine chemicals, lubricants, rubber products, paints and allied products, bitumen and tar, essential oils, inks, etc. The library of the Institution has accessioned 3,000 new specifications during the year, the total number of standard specifications in the library now being more than 10,000.

In the field of international co-operation, the Report recalls the sessions of the International Organisation for Standardisation (I.S.O.) Technical Committees for shellac and mica, commodities which, on an average, bring in foreign exchange to the extent of Rs. 15 crores every year. The sessions led to agreement on a majority of important points regarding international standardisation of shellac and mica.

Copies of the Report can be had from the Secretary (Administration), Indian Standards Institution, 19, University Road, Civil Lines, Delhi-8.